What is claimed is:

1. A method of coating a substrate, comprising:

exposing a substrate to an initiator capable of initiating a graft polymerization reaction on the substrate, to generate reactive radical sites on the surface of the substrate;

contacting the substrate with a composition comprising one or more monomers in a medium which has reversed phase properties compared to the substrate, in terms of hydrophilicity; and

graft polymerizing onto the substrate by forming covalent bonds between monomer molecules and the substrate at reactive radical sites on the substrate surface.

2. The method of claim 1, further comprising mixing the composition so that a plurality of said molecules remain in proximity to said reactive radical site.

3. The method of claim 1, wherein the monomers are grafted onto the substrate at a pressure less than about 50 atmospheres.

4. The method of claim 1, wherein the monomers are grafted onto the substrate at a temperature from about 10°C to about 100°C.

5. The method of claim 1, wherein the substrate is selected from the group consisting of solid synthetic polymers and solid natural polymers.

6. The method of claim 5, wherein the substrate is selected from the group consisting of polyolefin, silicone polymer, acrylic polymer, acrylic copolymer, polyesteracrylate,

polyestermethacrylate, fluoropolymer, vinyl polymer, vinyl monomer-containing copolymer, natural rubber, synthetic rubber, polyurethane, polyamide, polyester, epoxy polymer, wool, cotton, silk, rayon, and cellulose.

7. The method of Claim 6, wherein the substrate is selected from the group consisting of polyethylene, polypropylene, polyisobutylene, ethylene-alphaolefin copolymer, polyacrylonitrile, polymethylmethacrylate, polyethylmethacrylate, polyethylacrylate, polytetrafluoroethylene, chlorotrifluoroethylene, fluorinated ethylene-propylene, polyvinyl fluoride, polyvinyl chloride, polyvinyl methyl ether, polystyrene, polyvinyl acetate, polyvinyl ketone, ABS, latex rubber, butadiene-styrene copolymer, polyisoprene, polybutadiene, butadiene-acrylonitrile copolymer, polychloroprene polymer, polyisobutylene rubber, ethylene-propylenediene copolymer, polyisobutylene-isoprene, polyetherurethane, polyesterurethane, polycarbonateurethane and polysiloxaneurethane, Nylon 6, Nylon 66, Nylon 10, Nylon 11, modified cellulose, polyacrylamide, poly2-hydroxyethylacrylate, polyN,N'-dimethylacrylamide, polyacrylic acid, polymethacrylic acid, polyN-vinylpyrrolidone, polyvinylpyridine, polymaleic acid, poly2-hydroxyethyl fumarate, maleic anhydride, starch, and polyvinyl alcohol.

8. The method of claim 1, wherein the medium is a hydrophilic aqueous solution.

9. The method of Claim 8, wherein the medium contains one or more ions selected from the group consisting of sodium, ammonium, potassium, chloride, phosphate, and acetate buffers.

10. The method of claim 1, wherein the medium is hydrophobic, and comprises an organic solvent.

11. The method of claim 10, wherein the medium comprises a solvent selected from the group consisting of toluene, hexane, cyclohexane, and mixtures thereof.

12. The method of claim 1, wherein the initiator is selected from the group consisting of peroxide initiators, azo initiators, redox initiators, and photo-initiators/photosensitizers which can be thermally initiated.

13. The method of claim 12, wherein the initiator is a peroxide initiator selected from the group consisting of peroxyester, peroxyketal, peroxydicarbonate, ketone peroxide, dialkyl peroxide, diacyl peroxide, an inorganic peroxide, and mixtures thereof.

14. The method of claim 13, wherein the initiator is selected from the group consisting of 1,1-dimethyl-3-hydroxybutyl peroxyneodecanoate, α-cumyl peroxyneodecanoate, α-cumyl peroxyneoheptanoate, *t*-amyl peroxyneodecanoate, *t*-butyl peroxyneodecanoate, *t*-amyl peroxypivalate, *t*-butyl peroxypivalate, 2,5-dimethyl 2,5-di(2-ethylhexanoylperoxy)hexane, *t*-butylperoxy-2-ethylhexanoate, *t*-butylperoxyacetate, *t*-amylperoxyacetate, *t*-butylperbenzoate, *t*-amylperbenzoate, *t*-butyl-1-(2-ethylhexyl)monoperoxycarbonate, 1,1-di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane, 1,1-di(*t*-butylperoxy)-cyclohexane, 1,1-di(*t*-amylperoxy)-cyclohexane, ethyl-3,3-di(*t*-butylperoxy)-butyrate, ethyl-3,3-di(*t*-amylperoxy)-butylperoxy)-butylrate, di(*n*-propyl)peroxydicarbonate, di(*sec*-butyl)perosydicarbonate, di(2-ethylhexyl)peroxydicarbonate, 2,4-pentanedione peroxide, cumene hydroperoxide, butyl

hydroperoxide, amyl hydroperoxide, dicumyl peroxide, dibutylperoxide, diamylperoxide, decanoyl peroxide, lauroyl peroxide, benzoyl peroxide, hydrogen peroxide, potassium persulfate, and mixtures thereof.

15. The method of claim 12, wherein the initiator is an azo initiator selected from the group consisting of azobisisobutyronitrile, azobiscumene, azo-bisiso-1,1,1-tricyclopropylmethane, 4-nitrophenyl-azo-triphenylmethane phenyl-azo-triphenylmethane, and mixtures thereof.

16. The method claim 12, wherein the initiator is a redox initiator selected from the group consisting of peroxide-amine systems, peroxide-metal ion systems, and boronalkyl-oxygen systems.

17. The method of Claim 12, wherein the initiator is selected from the group consisting of 1,1-dimethyl-3-hydroxybutyl peroxyneodecanoate, α-cumyl peroxyneodecanoate, α-cumyl peroxyneoheptanoate, *t*-amyl peroxyneodecanoate, *t*-butyl peroxyneodecanoate, *t*-amyl peroxypivalate, *t*-butyl peroxypivalate, 2,5-dimethyl 2,5-di(2-ethylhexanoylperoxy)hexane, *t*-butylperoxy-2 ethylhexanoate, *t*-butylperoxyacetate, *t*-amylperoxyacetate, *t*-butylperbenzoate, *t*-amylperbenzoate, *t*-butyl-1-(2-ethylhexyl)monoperoxycarbonate, 1,1-di(*t*-butylperoxy)-3,3,5-trimethyl-cyclohexane, 1,1-di(*t*-butylperoxy)-cyclohexane, 1,1-di(*t*-amylperoxy)-cyclohexane, ethyl-3,3-di(*t*-butylperoxy)-butyrate, ethyl-3,3-di(*t*-amylperoxy)-butylperoxy)-butylrate, di(*n*-propyl)peroxydicarbonate, di(*sec*-butyl)peroxydicarbonate, di(2-ethylhexyl)perosydicarbonate, 2,4-pentanedione peroxide, cumene hydroperoxide, butyl hydroperoxide, amyl hydroperoxide, dicumyl peroxide, dibutylperoxide, diamylperoxide,

decanoyl peroxide, lauroyl peroxide, benzoyl peroxide, azobisisobutyronitrile, azobiscumene, azo-bisiso-1,1,1-tricyclopropylmethane, 4-nitrophenyl-azo-triphenylmethane, phenyl-azo-triphenylmethane, benzophenone, benzophenone derivatives, camphorquinone-N,N dimethyl-amino-ethyl-methacrylate, and mixtures thereof.

18. The method of claim 1, wherein the monomer is selected from the group consisting of hydrophilic monomers and hydrophobic monomers.

19. The method of claim 18, wherein the monomer comprises a hydrophilic monomer selected from the group consisting of hydroxyl substituted ester acrylate, ester methacrylate, 2-hydroxyethylacrylate, 2-hydroxypropylacrylate, 3-hydroxypropylacrylate, 2,3-dihydroxypropylacrylate, polyethoxyethylacrylate, polyethoxypropylacrylate, acrylamide, methacrylamide, N-methylacrylamide, N,N-dimethylacrylamide, N,N-dimethylmethacrylamide, N,N-dimethyl-aminoethyl, 2-acrylamido-2-methyl-1-propanesulfonic acid, N,N-diethyl-aminoethyl, 2-acrylamido-2-methyl-1-propanesulfonic acid, N-[3-dimethylamino)propyl]acrylamide, 2-(N,N-diethylamino)ethyl methacrylamide, polyethylene glycol acrylate, polyethylene glycol methacrylate, polyethylene glycol diacrylate, polyethylene glycol dimethacrylate; polypropylene glycol acrylate, polypropylene glycol methacrylate, polypropylene glycol diacrylate, polypropylene glycol dimethacrylate; acrylic acid, methacrylic acid, 2- and 4-vinylpyridine; 4- and 2-methyl-5-vinylpyridine, N-methyl-4-vinylpiperidine, 2-methyl-1-vinylimidazole, dimethylaminoethyl vinyl ether, N-vinylpyrrolidone, itaconic acid, crotonic acid, fumaric acid, maleic acid, and mixtures thereof.

20. The method of claim 18, wherein the monomer comprises a hydrophobic monomer

selected from the group consisting of ester acrylates selected from the group consisting of methyl, ethyl, propyl, butyl, phenyl, benzyl, cyclohexyl, ethoxyethyl, methoxyethyl, ethoxypropyl, hexafluoroisopropyl and n-octyl-acrylates; ester methacrylates selected from the group consisting of methyl, ethyl, propyl, butyl, phenyl, benzyl, cyclohexyl, ethoxyethyl, methoxyethyl, ethoxypropyl, hexafluoroisopropyl and n-octyl-methacrylates; acrylamides; methacrylamides; dimethyl fumarate; dimethyl maleate; diethyl fumarate; methyl vinyl ether; ethoxyethyl vinyl ether; vinyl acetate; vinyl propionate; vinyl benzoate; acrylonitrile; styrene; alpha-methylstyrene; 1-hexene; vinyl chloride; vinyl methyl ketone; vinyl stearate; 2-hexene; 2-ethylhexyl methacrylate, and mixtures thereof.

21. A method of coating a substrate, comprising:

exposing a substrate to an initiator capable of initiating a graft polymerization reaction on the substrate, to generate reactive radical sites on the surface of the substrate;

contacting the substrate with a composition comprising one or more monomers in a medium which has reversed phase properties compared to the substrate, in terms of hydrophilicity, while mixing the composition;

graft polymerizing onto the substrate by forming covalent bonds between monomer molecules and the substrate at reactive radical sites on the substrate surface; and

contacting the substrate with a cross-linking agent.

22. The method of claim 21, wherein the cross-linking agent is selected from the group consisting monomers having di- or multi-unsaturated functional groups.

23. The method of claim 22, wherein the cross-linking agent is selected from the group

consisting of diacrylates of polyethylene glycol, diacrylates of polypropylene glycol, dimethylacrylates of polyethylene glycol, dimethylacrylates of polypropylene glycol, trimethylolpropane triacrylate, trimethylolpropane trimethacrylate, di-trimethylolpropane, tetraacrylate, pentaerythritol tetraacrylate, tetramethacrylate, divinylbenzene, divinyl sulfone, silicone-containing diacrylates and dimethacrylates, and mixtures thereof.

24. The method of claim 1, wherein the substrate is silicone;

the initiator is an organic peroxide solution in tetrahydrofuran (THF);

the medium comprises from about 3% w/w to about 6% w/w acrylamide derivatives, from about 0.1% w/w to about 0.4% w/w diacrylate crosslinker, from about 10% w/w to about 20% w/w sodium chloride and from about 0.01% w/w to about 0.03% w/w polyvinylpyrrolidone; and,

the reaction is allowed to proceed at a temperature from about 80°C to about 95°C at atmospheric pressure.

25. The method of claim 1, wherein the substrate is silicone;

the initiator is an organic peroxide solution in tetrahydrofuran (THF);

the medium comprises from about 1.0% w/w to about 3.0% w/w acrylamide derivatives, from about 3.0% w/w to about 5% w/w polyethylene glycol acrylate, from about 10% w/w to about 20% w/w sodium chloride and from about 1.0% w/w to about 3.0% w/w polyvinylpyrrolidone; and

the reaction is allowed to proceed at a temperature from about 80°C to about 95°C at atmospheric pressure.

26. The method of claim 1, wherein the substrate is polyethylene;

the medium comprises from about 20 % w/w to about 40% w/w acrylamide, from about 1% w/w to about 3% w/w polyvinylpyrrolidone, and from about 10% w/w to about 20% w/w sodium chloride; and

the reaction is allowed to proceed at a temperature from about 80°C to about 95°C at atmospheric pressure.

27. The method of claim 1, wherein the substrate is selected from the group consisting of silicone, polyethylene, polyamide and latex, and wherein the grafting coats the substrate surface with a coating having characteristics selected from the group consisting of lubricious, hydrophilic and elastic properties.

28. The method of claim 1, further comprising attaching to the coated substrate a biological agent selected from the group consisting of penicillins, cephalosporins, fluoroquinolones, aminoglycosides, silver compounds, phenols, and biguanides.

29. A method of coating a substrate, comprising:

exposing a substrate to an initiator capable of initiating a graft polymerization reaction on the substrate, to generate reactive radical sites on the surface of the substrate;

contacting the substrate with a composition comprising one or more monomers in a medium; and

graft polymerizing onto the substrate at a pressure less than about 50 atmospheres by forming covalent bonds between monomer molecules and the substrate at reactive radical sites on the substrate surface.

30. The method of claim 29, wherein said graft polymerization is accomplished at a pressure less than about 10 atmospheres.

31. A medical device comprising:

a substrate constructed and arranged for insertion into a patient; and

a plurality of monomer molecules graft polymerized onto the surface of the substrate from a medium having reversed phase properties from the substrate, in terms of hydrophilicity.

32. A medical device according to claim 31, wherein the substrate is selected from the group consisting of guide wires, and catheters selected from the group consisting of PTCA catheters, cardiology catheters, central venous catheters, urinary catheters, drain catheters, and dialysis catheters.

33. A medical device according to claim 31, wherein the substrate defines at least one lumen, at least a portion of which is coated with monomer molecules graft polymerized to the lumen surface.

34. A medical device according to claim 33, wherein the substrate defines both interior and exterior surfaces of a lumen, and at least a portion of both the interior and exterior of the lumen is coated with monomer molecules graft polymerized to the lumen surface.

35. A system for forming a graft polymerized medical device comprising:

a substrate constructed and arranged for insertion into a patient;

an initiator capable of initiating a graft polymerization reaction on the substrate, to generate reactive radical sites on the surface of the substrate; and

a composition comprising one or more monomers in a medium which has reversed phase properties compared to the substrate, in terms of hydrophilicity.